ORAL CONTRIBUTIONS

837 Real-Time Three-Dimensional Echocardiography: Novel Clinical Applications

Tuesday, March 09, 2004, 10:30 a.m.-Noon
Morial Convention Center, La Louisiane A

10:30 a.m.

837-1 Live 3-D Echo as an Adjunct During Conventional 2-D Dobutamine Stress Echocardiography

Masood Ahmad, Zening Jin, Tianrong Xie, William Hendrix, Ildiko Agoston, University of Texas Medical Branch at Galveston, Galveston, TX

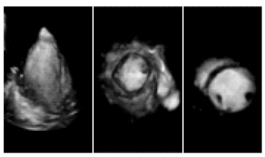
Background: Live 3-D echocardiography (3-D, Philips Medical Systems) has the potential to enhance diagnostic evaluation of patients undergoing Dobutamine Stress Echocardiography (DSE). However, its application during DSE has not been reported.
Methods: One hundred and forty-eight patients, age range 30-89yrs., were studied. All patients underwent conventional 2-D DSE. 3-D biplane and full volume images were obtained in parasternal and apical views at baseline and at peak stress by rapidly switching the transducers between 2-D and 3-D techniques. Cropping planes were used on-line to slice full volume images for visualizing LV/RV in multiple views. Wall motion was assessed in 3-D from serial short axis slices obtained from LV apex to base. 2-D and 3-D images were evaluated for segmental LV wall motion by two different observers. **Results:** Technically satisfactory 3-D images for comparison with 2-D were obtained in 140 patients. Based on the presence or absence of abnormal LV wall motion at baseline and on the presence or absence of ischemia at peak stress, comparisons between the two techniques showed an agreement of 86.2% at baseline (Kappa = 0.78) and 89.9% at peak DSE (Kappa = 0.84). LV wall motion scores by 2-D and 3-D were 1.06 and 1.05 at baseline, 1.09 and 1.12 at peak stress ($p<0.05$). Coronary angiograms were available in 57 patients. The sensitivity in detecting coronary artery disease was 76% by 2-D and 88% by 3-D. Out of 6 patients with non-diagnostic studies by 2-D, (no ischemia at submaximal heart rate), 3-D detected ischemia in 2 patients. **Conclusions:** Live 3-D echocardiography is feasible during conventional 2-D DSE. A higher LV wall motion score by 3-D at peak DSE may be due to a better definition of the extent of ischemia. Addition of Live 3-D to conventional 2-D DSE may enhance detection of coronoary artery disease. 3-D offers complimentary information and has advantages in assessing the extent of LV wall motion abnormalities from multiple vantage points.

10:45 a.m.

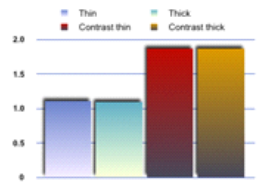
837-2 Contrast Improves Endocardial Border Definition Index in Real-Time 3-D Echocardiography

Stamatis Kapetanakis, David S. Mullins, Penelope Giannakopoulou, George Amin, Mark John Monaghan, King's College Hospital, London, United Kingdom

Background: Real-time three-dimensional echocardiography (RT3DE) is a new modality. As with 2D echo, endocardial delineation is limited in a substantial proportion of patients. The use of echo contrast has not been previously evaluated in RT3DE and may enhance endocardial border detection.
Methods: 50 patients (60% male, 62.5+/-11 years). RT3DE was performed with the Sonos 7500 and the X4 transducer. Contrast images were acquired with continuous infusion of Sonovue. Average acquisition time was 6 sec. 3D datasets were cropped to produce 4, 2 and 3 chamber views and a short axis view of the LV. Two cropping methods - thin and thick - produced 800 digital loops. 3 observers reviewed these for image quality and endocardial delineation. The Endocardial Border Definition Index (EBDI) was defined as total score for all segments reviewed divided by that number of segments.
Results: With contrast, there was significant improvement in image quality. More loops had adequate (59% of contrast images vs. 36.25%) or excellent (28.2% of contrast images vs. 8.5%) quality. Significantly fewer loops were uninterpretable when enhanced with contrast (0.75% of contrast images vs. 18.3%). There was a significant improvement in EBDI when images were enhanced with contrast (1.87+/-0.288 for contrast images vs. 1.09+/-0.55, $p < 0.001$) regardless of cropping.
Conclusion: Contrast enhanced RT3DE is feasible and provides rapid, high quality acquisition of 3D images. This technology will be especially valuable during Stress Echo.



3D Contrast
(FVA, Thick and Thin Slices)



EBDI

11:00 a.m.

837-3 Real-Time Three-Dimensional Echocardiographic Assessment of Endocardial Surface Can Quantitate the Size of Myocardial Infarction

Koichi Inoue, Hiroshi Ito, Katsuomi Iwakura, Shigeo Kawano, Atsunori Okamura, Koji Tanaka, Yuya Nishida, Kenshi Fujii, Sakurabashi Watanabe Hospital, Osaka, Japan

It is well known that ischemic myocardial damage is the most severe in the subendocardial layer. Real-time three-dimensional echocardiography (RT3DE) allows us to observe endocarial surface structure. The aims of this study were to characterize the endocardial surface structure of infracted myocardium and to assess the potential of RT3DE to quantitate the site and size of myocardial infarction (MI). **Methods.** We performed RT3DE in 17 patients with Q wave MI and 3 normal subjects with SONOS7500 (Philips). From apical approach, we recorded endocardial surface of ventricular septum, inferior and posterior wall with long-axis view and the other side of left ventricle by changing the direction of transducer.
Results. In normal subjects, the endocardial surface has rough folds of trabeculae and they shrink during systole. Surface of the infracted myocardium is characterized by 1) disappearance of folds (smooth surface), 2) high echoic, 3) no systolic deformation and 4) sliding movement. Three echocardiographers who were unaware of patient data diagnosed the infracted lesion, and their diagnosis coincided at the rate of 95.8%. Spatial extent of infarction was also well recognized. They classified the asynergy area volume (0: no, 1: $\leq$15% of LV, 2: $\leq$25%, 3: $\leq$35% of LV, 4>35% large) from visual inspection. Wall motion score calculated from 2D echo as sum of 17 segmental score (3=akinesia to 0=normal) was well correlated to the average of graded asynergy area volume ($r=0.94$, $p<0.0001$). **Conclusions.** We observed endocardial surface structure by RT3DE and found that infracted myocardium have typical features. The distribution and spatial extent of endocardial abnormalities observed by RT3DE is useful to diagnose the site and size of MI.

11:15 a.m.

837-4 Real-Time Three-Dimensional Echocardiography Is Superior to Two-Dimensional Echocardiography and Fluoroscopy in Guidance of Endomyocardial Biopsy

Miriam E. Amitai, Ingela Schnittger, Judy Chow, Patricia Brown, David H. Liang, Stanford University, School of Medicine, Stanford, CA

Background: Endomyocardial biopsy of the right ventricle is the standard method for monitoring rejection in heart transplant recipients. Although the procedure is generally performed under fluoroscopic guidance acute and chronic complications are not rare. 2D ultrasound can improve localization of the bioptome tip, however this tool still has limitations. The hypothesis of this study was that real time 3D ultrasound would improve the ability to identify the location of the biopsy. **Methods**:A total of 38 biopsy procedures were performed under usual fluoroscopic guidance and were monitored with 2D and 3D ultrasound on alternate passes of the bioptome. The operator performing the echocardiogram made a best effort to track the tip of the bioptome during the biopsy passes. No attempt was made to improve the image quality by positioning the patient or to alter the biopsies based on the echocardiographic information. The echo images were recorded on SVHS videotape and reviewed independently by two level 3 trained echocardiographers. The reviewers scored each biopsy pass for tip visualization and location of the biopsy (septum, apex or lateral wall) . **Results**:A total of 236-biopsy attempts were made during the 38-biopsy procedures. The location of the biopsy was determined in 82 % of the studies monitored with 3D echo, whereas 2D echo demonstrated the location in only 58 % of the biopsies ($p<0.0001$). On a procedure-by-procedure comparison, 3D echo was found to show the tip better in 31/38 vs. 3/38 for 2D echo ($p=0.0001$). In 4/38 neither method was clearly better. Of the 23 procedures in which both observers scored a preference for one echo method over the other, there was agreement in 21 (91%) as to which was the better technique. When both observers scored the location of the biopsy, there was 88% agreement on the biopsy location and 48% of biopsies were definitely from an unsafe location, resulting in 2 perforations and 1 tamponade. **Conclusions** 1)Real time 3D echocardiography improves the ability to see the location of the bioptome during biopsies. 2) Fluoroscopy alone is inadequate to ensure proper performance of endomyocardial biopsies.

11:30 a.m.

837-5 Proximal Flow Convergence Region as Assessed by Real-Time 3-D Echocardiography: Challenging the Hemispheric Assumption

Chaim Yosefy, Robert A. Levine, Judy Hung, Massachusetts General Hospital, Boston, MA

Background: Traditionally, the proximal flow convergence region (PFCR) is assumed to be a hemisphere when calculating mitral regurgitant (MR) flow and orifice area.This may not be valid given the elliptical configuration of the mitral orifice. Imaging of the PFCR by 2D echo limits full evaluation of the PFCR contour, which can be potentially be improved by 3D echo. We hypothesized that the PFCR is frequently not hemispherical but rather hemielliptical, given the shape of the mitral valve orifice. **Methods:** Fourteen patients with at least moderate functional MR were evaluated by 2D and real-time 3D (Philips 7500) in standard apical windows with optimized depth and color settings. **Results:** The 3D PFCR was hemispherical in shape in only one patient. Ten patients had an elliptical PFCR contour and 3 had a crescent shape, paralleling the proximal jet. Non-hemispheric contours persisted at all alias velocities from 10-50 cm/s. **Conclusions:** In patients with